PRESENT STATUS AND FUTURE PROSPECTS OF AMERICAN SHIPBUILDING.

Not since the early fifties has American shipbuilding enjoyed so large a measure of prosperity as that of to-day. Nearly a half million registered tons were added last fiscal year. On June 15, 1901, eighty-nine merchant ships and seventy-one war vessels were reported as being under construction, making a total of 135 vessels with a combined tonnage capacity of 488,700 tons. The trade authorities report that the shipyards engaged in building steel ships have orders which will require fully twelve months to fill, operating at their full capacity.[1] Wooden ship construction on the Maine coast and in the far northwest seems to be no less favored. For the past two or three years shipbuilders have been especially occupied with the construction of ships for the country's coasting trade, and for a longer period with the building of war vessels of various types. On the Atlantic seaboard the chief feature of progress in this industry has been in naval construction and in the evolution of a larger type of many-masted schooners. On the Great Lakes the steam-freighter types, with a maximum tonnage of 9,000 tons, gross register, are still the characteristic contribution of these inland seas to this phase of national development.

The shipbuilding industry on the Pacific Coast for the past three years, according to the *Scientific American's* reports, has enjoyed a period of extraordinary activity. From January, 1898, to September, 1900, thirty-two months, the number of new ships built aggregated seventy-four, with a total tonnage capacity of 37,910. Government vessels were not included in the list. Of the new craft, forty-five, with a tonnage of 14,229, were schooners, five were barkentines of 4,597 tons, one was a barge of 632 tons, and twenty-three

[1] Blue Book of American Shipping, Preface, 1901.

were steamers having a tonnage of 18,452. The largest of the schooners rated 985 tons, and of the steamers, 4,597 tons. Of the latter, three, aggregating 7,298 tons, were built of iron, the others of wood. San Francisco builders were the constructors of the larger number of both iron and wooden ships; but almost every port on the coast, from San Pedro to Puget Sound, wherever the necessary supplies of lumber were to be had, contributed to the total result. Creditable as the exhibit is, the outlook is even more flattering. There is not a shipbuilder along the 2,000 miles of coast who has not all the work contracted for that can possibly be handled and who could not easily duplicate his present undertakings if the supply of labor warranted it.

The cause of this prosperity is easily explained. For many years prior to 1898 the industry languished, and the carrying trade, which had been stimulated by artificial "booms," was greatly depressed. Dividends on marine property were small. The earnings were swallowed up by heavy expenses. Losses by sea were not made good. The actual number of coast ships was considerably decreased.

Just at the time when the maritime prospect seemed darkest the extraordinary development of Alaska began. It was found that the number of vessels available for this profitable traffic was far below the demand. Every vessel that could be procured was chartered for the Alaskan trade. High charters caused many to be withdrawn from the coast carrying trade, and a considerable scarcity of vessels for ordinary requirements began to be felt. Then came the revival of the Oriental trade, in which the Pacific shipbuilders found another pressing demand for their output. There appears from trade returns to be no abatement at any point. Owing later to South African conditions, the call for ships was still further improved. Besides these local evidences of prosperity the shipbuilding talent of the nation still holds the world's pennant in the making as well as in the management of pleasure craft, which the

growth of private wealth has enabled an increasing proportion of our citizens to enjoy. Largely for this and other purposes the United States has always built ships for sale to foreigners. Since the Civil War the annual tonnage of all kinds sold to foreigners has ranged from 10,000 to 80,000 tons in round numbers.

As yet the main demand for the product of our shipyards, with the exception of a few war vessels ordered by foreign governments, has come from the necessities of national defense and the requirements of our domestic development. But the progress of the iron and steel industry in this country, the necessity of finding foreign markets for our surplus manufactures and the extension of railway control over lake and ocean transportation, have all, among other causes, contributed to inaugurate a new era in the making of ships. Surplus capital is again going down to sea in ships. Now for the first time in our history is shipbuilding being organized on an extensive scale in the consolidated companies on the Lakes, on the individual enterprises on the New England coast, on the Delaware River, the Chesapeake Bay, the bay of San Francisco, and the Puget Sound. On the western rivers the output is still comparatively small, though not by any means losing ground.

The table on page 49 gives the tonnage built for twenty-two years.

The tonnage built on the Great Lakes has hitherto had almost no relation to the demand for ocean tonnage. Within a few years some vessels have left the lakes at the close of the season to engage in the coastwise trade between seasons. But as a rule the lake-built ships have had to limit themselves to fresh water requirements. Lake trade depends largely on raw materials and crude commodities. Additions to tonnage on these waters are directly affected by the volume of trade in agricultural products and the raw materials of industry.

Shipbuilding to-day in the United States stands on an en-

Progress of Shipbuilding in the United States.

[From Report of the Commissioner of Navigation.]

YEAR ENDING JUNE 30.	Built on seacoast.	Built on Mississippi and tributaries.	Built on Great Lakes.	Total annual addition.	Sailing Vessels.		Steam Vessels.		Total Built.
					Number.	Gross tons.	Number.	Gross tons.	Number.
	Tons.	Tons.	Tons.	Tons.					
1880	101,720	32,791	22,899	157,410	460	59,057	348	78,853	902
1881	125,766	81,189	73,504	280,459	493	81,209	444	118,070	1,108
1882	188,084	35,817	58,369	282,270	666	118,798	502	121,843	1,371
1883	210,349	26,443	28,638	265.430	721	137.046	439	107,229	1,268
1884	178,419	16,664	30,431	225.514	706	120.621	410	91,328	1,190
1885	121,010	11,220	26,826	159,056	533	65,362	338	84,332	920
1886	64,458	10,595	20,400	95,453	405	41,237	240	44,467	715
1887	83,061	10,901	56,488	150.450	447	34,633	299	100,074	844
1888	105 125	11,859	101,103	218,087	423	48,590	430	142,006	1,014
1889	111,852	12,202	107,080	231,134	489	50,570	440	159,318	1,077
1890 . . .	169,091	16,506	108,526	294,123	505	102,873	410	159,045	1,051
1891	237,462	19,984	111,856	369.302	733	144,290	488	185.037	1,384
1892	138,863	14.801	45,969	199,633	846	83,217	438	92,531	1,395
1893	102,830	9.538	99,271	211,639	493	49,348	380	134,308	956
1894	80,099	9,111	41,985	131,195	477	37,827	293	83 720	838
1895	67,127	8,122	36,353	111,602	397	34.900	248	69,754	694
1896	102,544	15,771	108,782	227.097	369	65,236	286	138,628	723
1897	103,504	11,792	116,937	232,233	338	64,308	288	106,153	891
1898	112,879	13,495	54,084	180,458	359	34,416	394	105,838	952
1899	196.120	23,552	80,366	300,038	420	98,073	439	151,058	1,273
1900	249,006	14,173	130,611	393,790	504	116,460	422	202,528	1,447
1901	291,516	22,888	169,085	483,489	526	126,165	506	273,591	1,580

tirely different basis compared with the position it occupied ten or twenty years ago. It has changed greatly as an industry in its relation to other industries, to the investing public, to commerce and to governmental policy. One does not readily realize how rapidly this branch of industry has grown in financial strength and in commercial value. Within a decade the capital invested has nearly trebled, wages earned have likewise doubled, and substantially the same may be said of both the expenditure for shipbuilding materials and of the value of the products of our shipyards. The number of establishments is about stationary. The number of plants in 1890 was 1,008; and in 1900, 1,083, only 77 more. The following table gives the status of the shipbuilding industry in the United States, exclusive of the United States navy yards, according to a preliminary report of the Census Bureau:

Items.	1900.	1890.
Number of establishments	1,083	1,006
Capital	$76,699,651	$27,262,892
Average number wage earners	46,121	22,143
Total wages	$24,388,109	$13,083,919
Miscellaneous expenses	3,582,257	1,392,351
Cost of materials used	33,031,280	16,521,246
Value of products, including custom work and repairing	73,444,753	38,065,410

The annual increase in our merchant marine represents the measure of demand for ships under the national flag. For the fiscal year ending June 30, 1901, this increase was 6.96 per cent over that of the preceding year. This rate is the highest since 1855. From the latter date to the present time the tonnage figures show a series of slow recoveries and abrupt reactions in the demands of our merchant marine upon the shipyards. As late as 1886 more than one-third of the annual increase in tonnage was sold to foreigners. Spasms of promise have so frequently been followed by col-

lapse that, in spite of our growing foreign commerce and our increasing importance as a naval power, our shipbuilding has concerned itself almost exclusively with meeting the requirements of our coastwise and interior commerce.

This is well brought out by a comparison of the documented tonnage in foreign and domestic trade and in fisheries on June 30, 1861, when the United States still had prominent rank in foreign trade, with that on June 30, 1901, when the total tonnage was nearly equal to that of forty years ago. The table shows that the coastwise trade has been absorbing our ships, and now utilizes four-fifths of the total tonnage of the country.

Documented Tonnage of the United States.

[From Report of Commissioner of Navigation.]

	1861. Tons.	1901. Tons.	Difference. Tons.
Foreign Trade . . .	2,496,894	879,595	—1,617,299
Coasting Trade . .	2,704,544	4,582,683	+1,878,139
Fisheries	338,375	61,940	— 276,435
Total	5,539,813	5,524,218	— 15,595

The reasons for the transformation implied in these figures are historical. As the writer has stated elsewhere,[1] from 1830 to 1890 our problems were essentially internal. Most of them for most of the time were intensely exacting. It was not that national lethargy had dulled the desire for ships, as some would have us think. That analysis is economically false to facts. For the time being our hands as a nation were full—full of work as honorable as shipbuilding and ocean commerce, and far more urgent and fundamental. The dominance of internal affairs over foreign commerce began to appear by the end of the first quarter of the cen-

[1] The Shipping Industry in the United States, p. 1383. United States Treasury Bureau of Statistics, December, 1900.

tury. Even as early as the war of 1812 our national problems gradually ceased to be maritime and became territorial. In 1824 a group of New York shipowners protested to Congress against the policy of economic isolation, by which capital and labor were induced to desert ocean commerce for the more remunerative pursuits of internal development. Only so long as that policy was in doubt did our ships maintain a foremost rank among maritime powers. As soon, however, as the "American policy" of economic isolation became continuous, then capital and labor employed in shipping, and consequently in shipbuilding for ocean trade, found themselves placed on an entirely different basis of earning power compared with that portion of the national capital and labor devoted to internal development. Capital devoted to shipbuilding for the sea trade had to earn returns under the stress of competition in the open world's markets, while the products of capital and labor within the national limits were sold in the national market, within which the prevailing rate of returns has always been higher than in the international market. On footings so clearly unequal, in a period of economic activity when the demand for labor and capital as a rule exceeded the supply, it was inevitable that the decadence of our merchant marine should coincide with the development of our domestic resources.

Now again the national interests have, by the logic of events, become maritime. Meanwhile the economic life of the people has also become more complex and comprehensive in its needs. From being primarily agricultural it has become industrial and then commercial. It is all of these that call for ships. Changes in our commercial relations with the world market have greatly modified the national attitude toward shipbuilding. The gains of our exports upon our imports during the latest decade have thrown upon the American producer the burden of finding over-sea markets for a growing surplus.

Growth in volume of ocean commerce of itself introduces

a new element into the question of the national demand for ships. By transferring an increasing proportion of the national surplus to the custody of the seas, to find markets, it calls for a more complete control of carrying agencies by those directly responsible for national prosperity. Private and public interests seem to coincide in requiring that no nation of an exporting rank such as is now held by the United States should delegate its maritime commerce to its national rivals.

The maritime arm of the distributive system, on which we are dependent for finding and holding such markets as our surplus needs, thus becomes part of the more complete commercial equipment which progress from an agricultural to a commercial nation has forced upon us. Until recently the emphasis was put on the home market in national discussion. Now we speak as world merchants and as world financiers. These comprehensive aims all tend to force surplus capital into a merchant marine, now that other channels of investment are no longer prejudicially profitable compared with shipping and shipbuilding. Between the home market and the world market the bridge of a national merchant marine is a logical necessity.

The present status of American shipbuilding has still further to be looked at from points of view that are peculiarly its own. The industry as it stands now is clearly connected in its development with the naval policy of the national government. This policy has resulted in calling into existence more shipbuilding plants operating on a larger scale and with more permanent conditions than the commercial demand succeeded in doing. It has drawn together mechanical equipment and engineering talent of a superior order to execute its contracts. It has distributed these contracts among shipyards on the seacoasts of the Atlantic and the Pacific in such a way as to equip every one of our great oceanic inlets, excepting those on the Gulf Coast, with superior shipyards. It has, by insisting that its vessels should be the products of

American skill and material, and of American model and design, attracted investing capital and constructive labor. All of these have helped to lay the foundations of a new order of things. It is true that the influence of naval policy is usually quite indirect in its effects on commercial shipbuilding, but the connection has been none the less promotive of industrial efficiency in this field. Competition among shipyards for governmental contracts has taken a wider range and been perceptibly keener with each successive award. Besides this general result, the high standard of workmanship required on governmental work has improved the grade and quantity of mechanical ability as applied to the building of steel merchant ships especially. Possibly there has been some disadvantage in turning a force of workmen from governmental work, where extreme carefulness is required, to commercial work where so high a degree of finish and nicety are not essential. But in the long run it cannot be disputed that the wholesale building of warships has helped to create large plants out of small ones and to develop the large ones to a point at which it is no longer industrially necessary to look to foreign shipyards for our merchant fleets of the future. A still more direct effect of naval policy upon commercial shipbuilding is seen where the mercantile auxiliaries constitute a feature of the merchant marine subject to naval service in time of war.

From what has already been said it is plain that our commercial prosperity has put us face to face with the shipping question. At present our financiers who underwrite our commercial organizations are buying foreign ships in the effort to bring railway and ocean rates of freight under common control. If financial considerations are allowed to govern in these consolidations of distributive agencies on land and on sea, as they undoubtedly will, it is not any longer a question as to where the ships will come from. One thing is certain, namely, that hitherto the ocean trade has not been in the habit of coming to the United States for its ships.

Now, however, that the demand for the establishment of a national merchant marine is heard with increasing insistence, the question of the capacity of the American shipyards to supply the ships is foremost.

Can American shipyards build merchant ships at a cost that will enable shipping interests to operate them in open competition with vessels from the older establishments of Great Britain or even with those of Germany? The answer to such a question involves comparisons very difficult to make on a common basis. The methods of work, the differences in design, cost of materials, wages, superintendence, interest, depreciation and insurance, expenses of operation and other items including the advantages of production on a large scale, have to be taken into account. One fact seems to be established beyond doubt, namely, that the first cost of an American-built ship is greater than that of a British-built ship of exactly the same size, dimensions and speed. The same seems to be true of German work. On this basis of capital cost, the depreciation, interest and insurance would probably amount to fifteen per cent per annum as fixed charges other than direct expenses of operation. If the American-built vessel cost $1,846,800 and the British-built vessel cost $1,419,120, these fixed charges would be respectively, $277,020 and $212,868, leaving the British-built vessel with an advantage of $64,152 annual outlay on first cost. These figures are taken from actual examples of construction cost in leading British and American shipyards,[1] to each of which identical contracts were awarded for vessels of the same plan and type. If this single instance be not taken as conclusive evidence on the subject of relative cost, it is necessary to go farther to show that in dealing with the world-wide problem of shipbuilding for the ocean trade, the American yards and the European yards still stand on a quite different basis as competitors.

It would probably not be disputed that in bridgebuilding

[1] Report of Commissioner of Navigation, 1901, pages 23-24.

Americans easily lead the British and the Germans. And the unanimous opinion would be that it is the result of our experience during a half century of bridging streams under such a variety of conditions as to make us masters of almost any possible problem that may arise anywhere else in the world. Precisely the same may be said in explanation of the success of British and the relative failure of American shipbuilding. No field of commercial and industrial invesment has been more liberally supplied with capital by the banks and the investing public than the shipbuilding and shipping interests of Great Britain. On the other hand, no American interest has been, until recently, so completely ignored as a rule by banks and investors generally as these phases of national enterprise—shipping and ship building. Until within a few years the American banker considered shipbuilding as an industry lying without the pale of legitimate investment. He belonged to a generation which knew nothing of the subject and cared less about it, when this field of investment was called to his attention. The history of American shipbuilding, like that of American farming, for the past fifty years is one of brave struggle to maintain an industry with a minimum of capital and hence a maximum of cost accompanied by the hazard of periodical depression. Financially it has been the most neglected of all our national industries.

Compare this with British shipbuilding, of which an experienced shipbuilder on the Pacific has said that it is the result of the very things we have not—prolonged and wide experience gained by shipowners and sailors, the embodiment of the principles of designing to meet universal conditions, the solution of problems worked out by the joint labors of naval architect, machinist, registration authorities and public criticism. American shipyards are still in the stage of adaptation to local conditions for the most part. On the lakes, within the limits of the local traffic requirements, the problems have been worked out as they arose with a high

degree of success. Likewise on the seaboard coastwise trade has preoccupied the attention of constructive progress, so that the cost has been brought within the limits of fairly profitable operation. But for the far greater problem of construction at a cost that will warrant investors in entering upon ocean competition, our shipyards have not yet proved themselves masters of their part of the situation.

In shop equipment American shops seem to excel in small tools and lifting appliances used in the handling of material. There are no such complete and economical methods of handling tools and materials by electricity anywhere in Europe as those of the Eastern Shipbuilding Company, at New London, and the New York Shipbuilding Company, at Camden, N. J. In large tools the American shop does not appear to be any better off. In engine building, as well as in the construction of the hull, the system of piece work is reduced to such a degree of precision in English shipyards that it is known or easily ascertained just what part of the total labor cost of a ship is to be charged to these parts of the work. Then there is a settled method of determining compensation for unit of product, while here no such uniformity has ever been agreed to. In spite of our advances in standardization in some directions, particularly in stationary engines, no such a complete system has been arrived at in the building of marine engines as that in British practice, where every part of an engine is gauged with precision to test the accuracy of the workmen's operations and the precision of the mechanics and tools used, so that without setting up the parts they may be sent to the ends of the earth with absolute certainty of fitting.

A comparison of foreign and domestic conditions leads to the impression that our shipbuilding industry is not evenly developed. In parts it is weak, as, for instance, in the development of standards of uniform cost of work. Higher wages per diem than is paid abroad still cover a multitude of sins of omission to organize work on the basis of results

accurately measured by uniform methods. In this direction there is room for development, if shipbuilding is to be brought up to the standard of organization in other industries. It has been stated that a standard-gauge system would reduce the cost of engine erection by as much as 50 per cent. Under American methods the same authority estimates that the labor cost on the hull of an average ocean going freight and passenger steamer, in an American yard, is 25 per cent more and the machinery 50 per cent more. Yet it is conceded that in point of quantity or output, in skill, in design, in handling machinery and in management our working force is superior.

Possibly the main reason for the difference in cost chargeable against our work lies in the variety of work which a shipyard has to do to keep itself going in the United States. Foreign shipyards have a continuous volume of work of a similar character, while our own yards work constantly on dissimilar designs and diverse specifications, so that it is the exception, rather than the rule, that the workman becomes familiar with his work from repetition of it in one ship after another. Almost every governmental order includes a more or less radical departure from previous specifications, so that naval requirements have hindered rather than helped toward reduction of cost by promoting similarity of type in construction. It is a matter of common knowledge that new types increase cost while standard types decrease cost. Protest after protest has been recorded against this mania for differentiation in type, but with little avail. In recently built merchant ships, both on the lakes and on the seaboard, the duplication of designs has become a matter of more frequent occurrence.

Another element of weakness in the shipbuilding situation in the United States is the large number of small and half-equipped yards and the small number of well-established ones. Excepting the Cramp shipyards, at Philadelphia, and possibly a few of lesser note, the United States has never

had a plant which devoted itself exclusively to this business without sooner or later meeting with financial failure. This is the record of the past twenty-five or thirty years. When demand for ships fell off the small yards have gone out of business for the time being. When prosperous trade called for more ships these very yards were given the contracts. In this way the burden for conserving and developing shipbuilding skill fell almost wholly on the few yards which remained in the business all the time. The wonder is not that we cannot build ships so cheaply as they are made in foreign yards, but that we can build them as well as we do under such conditions. The readiness with which a new plant can be called into existence, or an abandoned one revived, to get contracts is one of the marvels of this industry to foreigners.

It would not be fair to shipbuilders to omit one of their greatest difficulties in their attempt to develop their industry, a difficulty, moreover, which lies beyond their power to remedy under existing conditions of organization. No single element has been more embarrassing than the fluctuation in the prices of steel plates and angles. The price of shipbuilding steel has been known to increase 250 per cent in four months. This has no doubt somewhat abated, but on so high a level of prices as not to encourage the domestic manufacture of steel ships. British builders have the advantage of the steadying influences of the world's competition on prices of steel materials. For that reason they need never fear American competition in this field under existing differences in the cost of structural material. The high prices of steel material at home have no doubt something to do with the fact that on the seaboard 43,557 gross tons of wooden schooners and steamers were built last year, compared with 73,374 gross tons of steel steamers.

Nevertheless American shipbuilders and architects have made wonderful progress within a decade. They have gathered together the experience of the world on the subject. They have worked diligently and often unnoticed at every

phase of the problem. They have demonstrated their ability to design and construct, in the most satisfactory manner, with regard to time and efficiency, standard types of vessels for naval and mercantile service. Among the distinct contributions of this country to the making of ships should be mentioned the application of electrical power to the operation of machinery tools, cranes and other hoisting and handling methods, and the invention of small power tools, such as riveting, chipping, caulking and drilling appliances. All these advances lie in the direction of reduction in cost for unit of output. From this point of departure in further development two tendencies are at work. Within shipyards a more economical organization of the productive processes is going on to reduce costs by eliminating the unessential and by putting the emphasis on the essential elements of outlay. Such a process is slow and its results are not so quickly diffused from plant to plant as might be expected, notwithstanding the splendid spirit of comity among rival shipbuilders. The other tendency lies outside of the industry itself in the reduced cost of making shipbuilding materials, and in the growth of the demand for ships as a necessary extension of our distributive system. The problem of reducing the first cost of ships to the European level will have been solved when the annual output of our ship yards is five times what it now is. It is all a question of the volume of demand required by national development. The joint outcome of these two tendencies is inevitable. Meanwhile, in spite of all drawbacks the outlook is not only encouraging, but inspiring. Our national outlook has shifted to the sea politically, geographically and commercially. With this fact once fixed in the national consciousness clearly enough to see its connection with our past history and our present opportunity, it is not probable that any time will be lost in higgling over the terms on which these instruments of maritime power shall be called into being.

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